# Would greater household wealth make young children smarter?

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**Would greater household wealth make young children smarter?**[1]

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## Abstracts

Drawing on the Young Lives data obtained from three cycles of surveys from 2006 to 2016, our study examines factors affecting children's cognitive ability in Vietnam. Controlling for the conditional wealth, which is the residual of the regression equation of the household wealth index in 2006 and 2013, our study provides evidence that conditional wealth has an effect of increasing the cognitive capacity of 15-year-old children, manifested in all three methods of measurement: by vocabulary points, math scores and reading comprehension scores in Vietnamese. This finding once again confirms that late intervention after the first 1,000 days has a positive impact on children's cognitive ability. Notably, our finding suggests that using the conditional wealth enables to capture the impact of economic shocks, which in turn have a significant effect on the cognitive ability of children in Vietnam.

*Keywords: household wealth; conditional wealth; cognitive skills; the gender gap*
*JEL codes: J 10; J13: J16*

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## 1. Introduction

In the context of the rapid, comprehensive and extensive technological revolution, labor supply requirements in the labor market have also changed. Accordingly, workers must maintain their learning skills and pursue lifelong learning to be able to keep up with the changing trends in the labor market. To acquire such skills, workers need to improve their cognitive ability since they are at an early stage of development. According to Gottfredson (1997), cognitive ability is a general mental capacity, including reasoning, planning, abstract thinking, the ability to grasp general ideas, problem-solving, and learning from experience. Schmidt and Hunter (1998) point out that the cognitive ability of a worker is generally considered the best predictor of his performance at work. The main channel through which cognitive ability influences job performance is job knowledge acquisition (Borman et al., 1993). Possession of high cognitive ability enables people to acquire the knowledge they need for the best performance in their work. Lachman (2004) also confirms that cognitive abilities play a vital role in helping workers not only overcome job demands and challenges but also acquire higher education and further advanced training, as well as meeting societal expectations.

Grantham-McGregor et al. (2007) show that the development of children in the first years of life plays a particularly important role in later development. Figure 1 shows that nutritional factors are very important in brain development during the first years of a child's life. Black et al. (2016) share this view when they demonstrate that the period from conception to the age of about 2 years (i.e., the first 1,000 days) is a time when nutrients have the most powerful influence on a child's development, cognitive ability and academic performance later on.

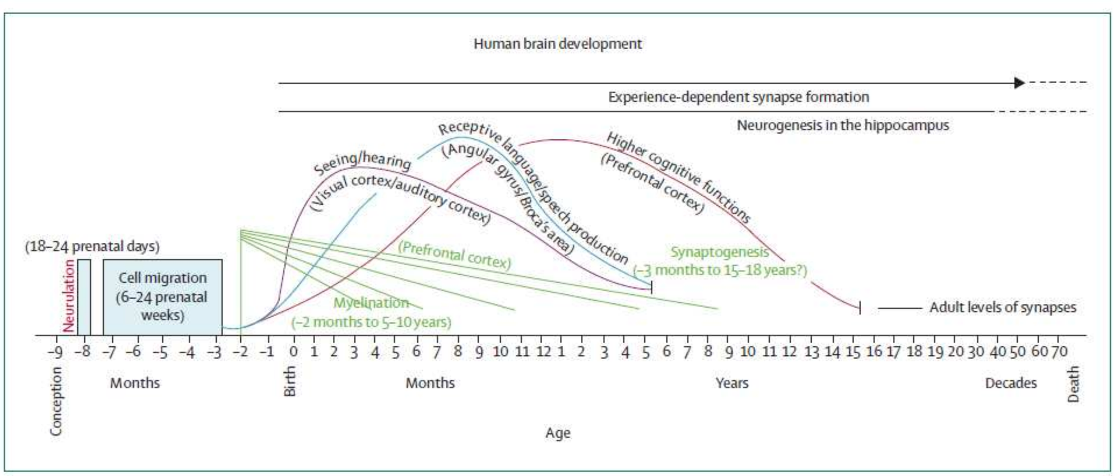


Figure 1: The development process of the human brain

*Source: Grantham-McGregor et al. (2007).*

A number of studies have examined factors affecting children' cognitive abilities in several developing countries. Using data for a group of children born in 2001-2002 in Peru in the Young Lives survey data set, Crookston et al. (2011) finds that for cognitive vocabulary tests (PPVT), the influence of nutrition at 5 years of age is stronger than that of nutrition in early childhood (6-18 months). In contrast, there was no difference shown in math tests in the influence of nutrition on the cognitive ability of Peruvian children from early childhood to 5-6 years of age. This result is in line with that of Black et al. (2016) and provides additional evidence that interventions after the first 1,000 days still have a positive effect on the cognitive development of children. Cheung (2006) also supports this finding when he shows that the weight index of children at 1 year of age has no effect on a child's cognitive test at 7 years of age. In contrast, the factor that has a positive effect on the cognitive abilities of 7-year-old children in Indonesia is the rate of weight gain between 1-7 years of age.

Meanwhile, Crookston et al. (2014) measure cognitive competence through test results for math, vocabulary and language use, and reading comprehension. Accordingly, numerical tests include addition, subtraction, multiplication, division, solving equations, measuring, interpreting data, and basic geometry. The vocabulary test (PPVT) uses encouraging words with pictures or pictures alone to test vocabulary acquisition skills. The test on language skills and reading comprehension included 24 paragraphs of varying degrees of difficulty for children to read. Each paragraph consisted of sentences or short paragraphs that had one or several words missing. The child was then asked to identify the missing word and type it in the blank and eventually, the child had to translate the complete sentence or paragraph into their native language. Based on the results of the three types of test, the author established the results for each child's cognitive scores to include in the analysis of results for the child's nutritional condition.

Using data from more than 3,000 children from four countries (Ethiopia, India, Peru and Vietnam), Crookston et al. (2014) investigated the relationship between cognitive attainment and household economic conditions, education and source, and nutritional factors to assess their influence on the development of children's cognitive ability. Their study showed a positive and statistically significant relationship between the individual factors, households, and children's cognitive ability in all four countries. Accordingly, if parents have received some education, if their household economic conditions improve, or if their children grow well, then their cognitive scores will increase over time. However, the method used by the authors did not control for a significant factor, namely the height of the mother (an element that is thought to have a significant effect on the height of the child). Controlling for the mother's height, if this is about the same as the height of the child, and for the child's cognitive growth will overcome this deficiency.

Using Vietnam's 2001-2002 national health survey data to analyze the impact of household socio-economic status on children's health, Sepehri and Guliani (2015) find that, on average, children from better-off households will be taller than children from poorer households, and this gap decreases with children in the older age group. Thus, when a household's economic situation improves, the physical health of children also improves significantly, especially for children aged 0-3 years. Also, Le (2011) studied the relationship between height and the cognitive development of Vietnamese children aged 5, using the Young Lives data. Vocabulary awareness (PPVT) was used to measure a child's cognitive capacity. The results of the analysis showed that besides the factors of parental education and urban/rural factors that affect the perception of 5-year-old children, additional factors directly related to a newborn's health, measured by preterm/full-term pregnancy, also play a vital role in a child's vocabulary test. However, the influence on cognitive ability of height or number of months at birth of 5-year-old children is not statistically significant.

Using survey data on children, with nearly 1,000 observations among older children, Le and Tran (2015) have shown that the height factor in children at the age 8 and 15 has a positive influence for cognitive capacity. This means that adequate nutrition in the years after the first 1,000 days has a significant effect on the height and cognitive capacity of Vietnamese children. However, this study lacks necessary information about the characteristics of infants at birth, so it is not possible to assess the influence of birth factors and of the first 1,000 days on the cognitive capacity of children 15 years of age. A recent study by Le and Behrman (2017) uses Young Lives data to assess the predictive ability of three nutritional indicators in the first year of life, including birth weight, increase in height, and weight gain in the first year after birth. Their results indicate that although these three factors in the 12 months postpartum serve as anthropometric indicators for children at the age of 8, they are not statistically significant in predicting the cognitive ability of 8-year-old children, when measured by reading test scores, math test scores and vocabulary awareness (PPVT).

The aforementioned literature reveals that while numerous studies have investigated various factors affecting children' cognitive ability, no study thus far has examined the impact of families' economic status on their children's cognitive ability in Vietnam. In particular, household wealth helps children grow physically, but the benefit of physical growth for cognitive ability has remained uncovered. Cognitive ability is a particularly important factor in career development as well as in the life of an adult. This ability needs to be fostered and developed right from the first years of a child's life. Considering the importance of research topic and the gap in the literature, our study is the first to examine the impact of household wealth on children's cognitive ability in Vietnam.

## 2. Data and method

### *2.1. Data*

Young Lives is an international study of child poverty, conducted to contribute to raising our awareness of the causes and consequences of child poverty in both developing and providing countries. In Vietnam, the Young Lives study was conducted with the participation of two organizations. The Center for Analysis and Forecasting (CAF) of the Vietnam Academy of Social Sciences (VASS) is the main research partner in Vietnam for Young Lives and the other is the General Statistics Office. Young Lives was designed as a cohort study of the lives of 12,000 children in four low- and middle-income countries — Ethiopia, India (in Andhra Pradesh and Telangana), Peru and Vietnam, covering a span of over 15 years, beginning in 2002 through to the end of 2017. The sample in each country consists of two groups of children: one group of 2,000 millennials (born in 2001 and 2002) and an older group of 1,000 7-year-olds born in 2000. Those were the first generations to benefit from the country's economic development achievements after the economic reform.

The Young Lives data were taken from a representative sample for the poor, in different geographical areas, and with a similar proportion of ethnic minorities represented in the national total. Including ages from infancy to adulthood, Young Lives not only monitors children's physical and social circumstances but also captures their views on life and their aspirations for the future. Five quantitative surveys of children, households and communities were conducted in Vietnam in 2002, 2006, 2009, 2013 and 2016 (Figure 2), collecting information on households as well as children's views of their subjective well-being and perceptions of poverty. In parallel with the quantitative surveys, four qualitative survey cycles were conducted with a group of young children in the 2007-2014 period. Through in-depth interviews with children and parents, teachers, and friends, as well as local staff, qualitative surveys have provided the data for case studies investigating how children's lives change, and how the environment and national or regional policies affect their lives.


Figure 2: Five rounds of YL investigation in Vietnam

***2.2. Study indicators***

*2.2.1. Measure of cognitive skills*

Many indicators reflect a child's cognitive ability, of which the three most common are math scores, reading comprehension, and vocabulary (Peabody Picture Vocabulary Test -PPVT).

*Math scores*

In cycle 4, the math test for young children consisted of 34 questions. Each question asked the children to make a calculation, such as addition, subtraction, multiplication, and division with whole numbers, decimals, fractions, or counting squares and triangles. Some questions require children to find the logical rule of a sequence and fill in the missing space in the sequence. In this test, there are also more complex problems, such as calculating the area, or analyzing a prescription to calculate the amount of medicine to be taken. Subsequent questions become more difficult than earlier ones. Each student takes the math test individually and is allowed 40 minutes to complete it. Math tests must be taken in a quiet place and to ensure objectivity and avoid fatigue, are not performed before 7 am or after 5 pm.

*Vietnamese score*

The Vietnamese language test measures reading and comprehension at different levels of complexity (for example, single words, sentences, and paragraphs with multiple levels). For the Vietnamese test in cycle 4, a group of young children read five paragraphs or poems, and for each paragraph or poem had to answer six multiple choice questions. Children chose one of the answers given with information taken from a passage or verse that had been read. There were 30 questions in total to complete within 30 minutes. In cycle 5, the comprehension test had two paragraphs and one diagram. There were six questions after each paragraph or diagram, for a total of 18 questions.

*Peabody Picture Vocabulary Test (PPVT)*

To assess the cognitive capacity of children, vocabulary scores (PPVT) commonly used by previous studies in the Young Lives dataset include Blau (1999), McCulloch and Joshi (2002), Paxson and Schady (2007), Le (2011), Le and Tran (2015). In the PPVT test, children listened to a word read by the investigator and then looked at four different images. Children would choose which image they thought best represented the meaning of the word that they had heard. The vocabulary test through flip-flops is not limited in time, but if after about 15 minutes children have not given an answer, the interviewer should encourage them to do so. The flipbook vocabulary test cannot be adapted for use in all languages, meaning that the test can only be performed in a predefined language. For the research group of children, the test was designed in Vietnamese. Translating the test into another language (for example, into the local language) will affect the accuracy of the results. Therefore, children who cannot speak Vietnamese do not take this test.

The number of questions in the fourth and fifth cycles is only one-third of the standard number in the second and third cycles, due to the alignment of Young Lives experts with specific principles (see more in Leon & Singh (2017)).

*2.2.2. Measure of household wealth*

Household wealth is measured by a wealth index, which is defined as the average of three components, including housing quality, access to services, and the availability of consumer durables. To be more specific, housing quality is measured by the average number of rooms per person and the quality of the materials used to construct house walls, roofs and floors. The second component – access to services – includes access to electricity, safe drinking water, non-polluting energy for cooking, and sanitation facilities. The last component comprises household items that members own, such as a TV, radio, motorbike, automobile, mobile phone, landline phone, bicycle, fan and refrigerator.

*2.2.3. Controlling factors*

The controlling variables for this study include a set of child characteristics, household characteristics and economic regions. Child characteristics consist of gender, height at birth, and ethnicity while household characteristics include the mother's schooling, height, weight, and household size. We also include urban/rural and economic region dummies to control for regional fixed effects.

***2.3. Statistical methods***

The literature review confirms that the household wealth of children at an older age is strongly correlated with household wealth when children are 5 years of age. Thus, the effect of early childhood wealth on children's cognitive skills at the age of 5 may contribute to the link between household wealth and children's cognitive skills at the age of 15.

*2.3.1. Conditional wealth*

To investigate the effect of change in household wealth on children between 5 and 15 years, this study applies the conditional wealth formula introduced by Le (2019). The indicator is the residual term of the following ordinary least squares (OLS) regression:

$$Wealth\ index_4 = \beta_0 + \beta_1 wealth\ index_2 + C_{24} \quad (1)$$

Where $wealth\ index_2$ and $wealth\ index_4$ are the wealth indexes in the second survey cycle (children 5 years of age) and in the fourth survey cycle (children 12 years of age). Conditional wealth, $C_{24}$, enables to capture the impact of economic shocks that may occur during the period between survey cycle 2 and cycle 4 (Le, 2019).

*2.3.2. Modeling the effect of conditional wealth on cognitive skills*

This study analyses the association between changes in household wealth and the cognitive skills of children at the age of 15. Conditional wealth $C_{24}$ serves as a proxy for change in household wealth between the status of a child 5 years of age and that of a child of 12 years. Other controlling factors are given for 5-year-olds. The regression analysis follows the equation (2):

$$Cognitive_{5i} = \beta_0 + \beta_1 X_i + C_{24} + u_i \quad (2)$$

Where *cognitive* is measured by *maths score*, *overall reading score,* and the *Peabody Picture Vocabulary Test score (PPVT)* in the cycle 5 survey (children aged 15). $X_i$ represents (i) children's characteristics, such as gender, ethnicity, health status, height, weight; (ii) household characteristics, such as house index, wealth index, household size, mother's height, mother's education; and (ii) characteristics of economic regions and urban/rural areas. $u_i$ is an error term. Definition and measurement of included variables are given in Appendix 1.

**3. Results and discussion**

Table 1 reports the estimation results using the OLS method with dependent variable being the PPVT, math and reading scores, respectively, for 15-year-old children, and does not control for changes in household wealth in the 2006-2013 period.

Measuring the cognitive ability of children aged 15 by the vocabulary scoring method (PPVT) shows that there is no difference between the sexes when the estimated coefficients are not statistically significant. In contrast, factors such as urban setting and infant height have a positive impact on the PPVT index of 15-year-old children. In the second cycle, factors such as ethnicity, household wealth index, and geographical factors influence the vocabulary of 15-year-old children. Specifically, children with Kinh mothers and children living in households with a higher wealth index have higher vocabulary scores than do 15-year-olds of other ethnic groups.

By contrast, the more crowded the household, the lower the vocabulary ability of children aged 15. Generally, the likelihood of children interacting with their family members increases in a large household, and therefore vocabulary ability also increases. It is possible, however, that in a large household the adults may have to spread resources and care time, so there is less time to interact with children. Therefore, in order to be able to further analyze the influence of household size on a child's vocabulary, it is necessary to take into account the age structure of household members. Finally, compared to 15-year-old children in the Red River Delta, children in other economic regions, such as the Northern Uplands or Central Coast region, have lower vocabulary scores.

When measuring cognitive ability by math scores and reading comprehension, the results are significantly different from those obtained by testing PPVT vocabulary. Specifically, the results by gender show that 15-year-old boys have lower test scores than 15-year-old girls in both math and reading comprehension in Vietnamese. That the reading comprehension score of girls is higher than that of boys comes as no surprise because girls often have a higher language ability than boys. Math scores that are lower for 15-year-old boys than for girls of the same age need to be analyzed more closely. Urban children scored higher in both math and reading tests than rural children.

**Table 1**: **Factors affecting the cognitive ability of 15-year-old children**
(Without control for conditional wealth)

| Explanatory variables | (1) PPVT | (2) Maths | (3) Reading |
|---|---|---|---|
| Male | -0.205 | -0.861*** | -1.634*** |
| | (-0.52) | (-3.04) | (-7.46) |
| Urban | 1.611** | 2.657*** | 2.235*** |
| | (2.39) | (5.49) | (5.97) |
| Mother of Kinh ethnic group | 7.458*** | 1.461** | 2.021*** |
| | (9.53) | (2.53) | (4.54) |
| Length/height-for-age z-score | 0.468*** | 0.300** | 0.181** |
| | (2.87) | (2.55) | (1.99) |
| Mother's height | 0.0228 | 0.0769*** | 0.0269 |
| | (0.57) | (2.70) | (1.22) |
| Mother's weight | -0.0248 | -0.0518** | -0.0340* |
| | (-0.77) | (-2.23) | (-1.89) |
| Wealth index in cycle 2 (2006) | 10.29*** | 10.12*** | 7.270*** |
| | (7.10) | (9.70) | (9.01) |
| Household size | -0.140 | -0.0682 | -0.0227 |
| | (-1.27) | (-0.86) | (-0.37) |
| Northern Uplands | -1.533** | -1.277** | 1.098** |
| | (-1.99) | (-2.30) | (2.56) |
| Central Coastal | -6.401*** | -0.993** | -0.0885 |
| | (-10.19) | (-2.20) | (-0.25) |
| Mekong River Delta | -0.592 | 0.0971 | 1.416*** |
| | (-0.87) | (0.20) | (3.75) |
| Constant | 49.72*** | 0.130 | 6.510** |
| | (8.88) | (0.03) | (2.09) |
| Observations | 1816 | 1781 | 1783 |
| Adjusted R2 | 0.231 | 0.188 | 0.172 |
| F-Statistics | 51 | 38 | 35 |
| Prob > F | 0.000 | 0.000 | 0.000 |

*Robust standard errors in parentheses.* * p<0.10, ** p<0.05, *** p<0.010
*Sources: Author's calculation from YL data*

Similarly, children living in households with a higher wealth index also have higher scores on math and reading tests. This difference can be explained in two ways. Firstly, children in urban areas and children living in better-off households are better cared for and enjoy better nutrition. Consequently, these children develop better physical strength, and their cognitive ability is also higher. Secondly, children in families with a higher wealth index and living in urban areas have greater opportunity to access extra courses, so they will have better test scores for reading and comprehension. While the factor of the mother's height made no difference to the reading comprehension score of 15-year-old children, this factor had a significant influence on the math test results. Finally, considering geographic areas, 15-year-old children living in the Northern Uplands and in the Mekong River Delta had higher reading comprehension scores than 15-year-old children in the Red Delta region.

We further examine factors affecting children's cognitive ability with additional control for the economic growth factor. The economic growth is measured by the residuals predicted from the regression model based on the household wealth index in 2006 and 2013. Results of detailed estimates are shown in Table 2. When controlling for the economic growth factor by controlling for the residual element of the household wealth index in the 2006-2013 period, the results reveal that this growth factor has a positive, meaningful effect.

**Table 2**: **Factors affecting the cognitive capacity of 15-year-old children with controlling for the residual wealth index from 2006 to 2013**

| Explanatory variables | PPVT | MATHS | READING |
|---|---|---|---|
| Male | -0.187 | -0.821*** | -1.603*** |
| | (-0.47) | (-2.83) | (-7.18) |
| Urban | 3.005*** | 4.017*** | 3.234*** |
| | (4.60) | (8.44) | (8.82) |
| Mother Ethnic is Kinh | 8.961*** | 2.976*** | 3.110*** |
| | (11.83) | (5.24) | (7.12) |
| Length/height-for-age z-score | 0.499*** | 0.333*** | 0.203** |
| | (3.03) | (2.76) | (2.18) |
| Mother's height | 0.0344 | 0.0868*** | 0.0334 |
| | (0.86) | (2.97) | (1.49) |
| Mother's weight | -0.00564 | -0.0327 | -0.0203 |
| | (-0.17) | (-1.38) | (-1.11) |
| Household size | -0.135 | -0.0622 | -0.0177 |
| | (-1.21) | (-0.76) | (-0.28) |
| Northern Uplands | -3.177*** | -2.793*** | -0.00566 |
| | (-4.24) | (-5.10) | (-0.01) |
| Central Coastal | -7.514*** | -2.036*** | -0.843** |
| | (-12.14) | (-4.52) | (-2.43) |
| Mekong River Delta | -2.740*** | -1.947*** | -0.0518 |
| | (-4.37) | (-4.29) | (-0.15) |
| Conditional wealth | 1.726*** | 0.991*** | 0.753*** |
| | (4.46) | (3.49) | (3.43) |
| Constant | 51.70*** | 2.229 | 8.094** |
| | (9.17) | (0.54) | (2.55) |
| No. of Obs. | 1814 | 1779 | 1781 |
| Adjusted R2 | 0.219 | 0.150 | 0.141 |
| F-Statistics | 47 | 30 | 28 |
| Prob > F | 0.000 | 0.000 | 0.000 |

*Robust standard errors in parentheses.* * $p<0.10$, ** $p<0.05$, *** $p<0.010$

*Sources: Author's calculation from YL data*

The increasing cognitive ability of 15-year-old children using all three measurement methods – PPVT, math and reading scores – is statistically significant. The regression results show that in the condition that other factors remain unchanged, if the conditional wealth increases by 1 standard deviation of children at 5 years old, the test scores of PPVT, math and reading scores of children at 15 years old will increase to 1.73; 0.99 and 0.75 points respectively. This result is quite similar to the conclusion by Georgiadis et al. (2017) which shows that the economic development of households after the child has gone through the initial growth stage still has a positive influence on the child's cognitive development.

## 4. Concluding remarks

Exploiting the Young Lives data through three cycles of surveys from 2006 to 2016, carried out with 2,000 children in five provinces in Vietnam, we examine factors affecting the cognitive ability of 15-year-old children. Our regression model controlled for various important characteristics of children at birth as control variables, including household characteristics, height, mother's weight, economic region, and notably economic development factors in the 2006-2013 period. As already discussed, it was important to control for the economic growth factor when estimating factors affecting children's cognitive ability.

In our study, the economic growth factor is proxied by the residual of the regression equation of the wealth index in 2006 and 2013. Our research confirms that economic development through change in household wealth in the 2006-2013 period actually has the effect of increasing the cognitive capacity of 15-year-old children. This result was manifested by all three methods of measurement according to vocabulary points, math scores and reading comprehension scores in Vietnamese, with a statistical significance of 5% for the vocabulary and 1% for the other two factors, math scores and reading comprehension. This finding once again confirms that late intervention after the first 1,000 days has an impact on children's cognitive ability. Notably, our finding suggests that economic development plays a key role in enhancing the cognitive ability of children in Vietnam.

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**Appendices**

Appendix 1: Definition and measurement of variables

| Variable | Description of the variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| ppvt_raw | Vocabulary scores | 1,856 | 58.24784 | 8.366149 | 17 | 74 |
| mathr5 | Math scores | 1,825 | 14.32274 | 6.58917 | 0 | 30 |
| readr5 | Reading scores | 1,828 | 14.01149 | 5.042282 | 0 | 25 |
| gender | Gender of the children (1=male; 0 = female) | 1,867 | 0.5152651 | 0.499901 | 0 | 1 |
| urban | Urban area (1= urban; 0= rural) | 1,867 | 0.1831816 | 0.386919 | 0 | 1 |
| ethnic | Ethnicity of children (1= Kinh (majority); 0 = Minority | 1,867 | 0.8585967 | 0.348531 | 0 | 1 |
| ethnic_mom | Ethnicity of children's mother (1= Kinh (majority); 0 = Minority | 1,867 | 0.862346 | 0.344629 | 0 | 1 |
| zhfa | Length/height-for-age z-score of children | 1,860 | -1.122806 | 1.329042 | -7.15 | 9.37 |
| wealth_ind~2 | Wealth index of households in survey round 2 (2006) | 1,849 | 0.4894208 | 0.177499 | 0.006173 | 0.935185 |
| hhsize | Household size | 1,867 | 4.602571 | 1.376013 | 1 | 15 |
| region_1 | Northern Uplands | 1,867 | 0.1976433 | 0.398328 | 0 | 1 |
| region_2 | Red River Delta | 1,867 | 0.2072844 | 0.40547 | 0 | 1 |
| region_3 | Central Coastal | 1,867 | 0.390466 | 0.487986 | 0 | 1 |
| region_4 | Mekong River Delta | 1,867 | 0.2046063 | 0.403522 | 0 | 1 |
| ehat_c24_stan | residual from wealth index from round 2 to round 4 divided by the standard deviation of wealth index in survey round 2 (Children are at 5 years old) | 1,827 | 3.09e-10 | 0.5113311 | -2.53752 | 2.080158 |

Appendix 2: Factors affecting the PPVT of 15-year-old children controlling for the residual wealth index from 2006 to 2013 via OLS and quantile regression

| | OLS | Q(0.10) | Q(0.25) | Q(0.50) | Q(0.75) | Q(0.90) |
|---|---|---|---|---|---|---|
| Gender | -0.187 | -0.659 | -0.459 | -0.327 | -0.400 | 0.399 |
| | (-0.47) | (-0.61) | (-0.91) | (-0.66) | (-1.03) | (1.03) |
| Urban | 3.005*** | 4.634** | 5.297*** | 3.084*** | 2.564*** | 1.362* |
| | (4.58) | (2.59) | (6.40) | (3.76) | (3.99) | (2.14) |
| Ethnic mom | 8.961*** | 11.56*** | 9.735*** | 8.866*** | 6.068*** | 5.716*** |
| | (10.19) | (5.58) | (10.14) | (9.33) | (8.14) | (7.75) |
| zhfa | 0.499** | 0.620 | 0.479* | 0.470* | 0.333* | 0.325* |
| | (3.07) | (1.37) | (2.29) | (2.27) | (2.05) | (2.02) |
| Mother height | 0.0344 | -0.0611 | -0.00483 | 0.0246 | 0.00711 | -0.0244 |
| | (0.96) | (-0.56) | (-0.10) | (0.49) | (0.18) | (-0.63) |
| Mother weight | -0.00564 | 0.0289 | 0.0136 | -0.00790 | 0.00178 | 0.0318 |
| | (-0.19) | (0.32) | (0.33) | (-0.19) | (0.06) | (1.00) |
| Household size | -0.135 | -0.141 | -0.174 | -0.0937 | -0.112 | -0.0645 |
| | (-1.20) | (-0.46) | (-1.23) | (-0.67) | (-1.02) | (-0.59) |
| Northern Uplands | -3.177*** | -1.321 | -2.070* | -3.312*** | -3.818*** | -3.702*** |
| | (-4.23) | (-0.65) | (-2.18) | (-3.53) | (-5.19) | (-5.08) |
| Central Coastal | -7.514*** | -8.233*** | -8.882*** | -8.567*** | -6.827*** | -4.768*** |
| | (-12.37) | (-4.86) | (-11.32) | (-11.03) | (-11.21) | (-7.91) |
| Mekong River Delta | -2.740*** | -1.028 | -2.118** | -3.654*** | -3.617*** | -3.703*** |
| | (-5.12) | (-0.60) | (-2.66) | (-4.65) | (-5.87) | (-6.07) |
| ehat_c24_stan | 1.726*** | 1.748 | 1.476** | 1.384** | 1.576*** | 0.377 |
| | (4.29) | (1.65) | (3.01) | (2.85) | (4.14) | (1.00) |
| Observations | 1814 | 1814 | 1814 | 1814 | 1814 | 1814 |

*Robust standard errors in parentheses.* * p<0.10, ** p<0.05, *** p<0.010

*Sources: Author's calculation from YL data*

Appendix 3: Factors affecting the MATHS score of 15-year-old children controlling for the residual wealth index from 2006 to 2013 via OLS and Quantile Regression

| | OLS | Q(0.10) | Q(0.25) | Q(0.50) | Q(0.75) | Q(0.90) |
|---|---|---|---|---|---|---|
| Gender | -0.821** | -0.688* | -0.740* | -0.712 | -0.960* | -1.097* |
| | (-2.84) | (-2.03) | (-2.12) | (-1.62) | (-2.12) | (-2.47) |
| Urban | 4.017*** | 2.702*** | 4.042*** | 5.381*** | 4.347*** | 3.742*** |
| | (8.28) | (4.85) | (7.05) | (7.43) | (5.83) | (5.12) |
| Ethnic mom | 2.976*** | 2.167** | 1.293 | 2.524** | 3.618*** | 5.541*** |
| | (5.94) | (3.26) | (1.89) | (2.92) | (4.06) | (6.35) |
| zhfa | 0.333* | 0.168 | 0.378** | 0.528** | 0.151 | 0.175 |
| | (2.54) | (1.19) | (2.60) | (2.87) | (0.80) | (0.94) |
| Mother height | 0.0868** | 0.0775* | 0.110** | 0.0688 | 0.114* | 0.102* |
| | (2.84) | (2.27) | (3.12) | (1.55) | (2.49) | (2.27) |
| Mother weight | -0.0327 | -0.0524 | -0.0586* | -0.00594 | -0.0267 | -0.0299 |
| | (-1.34) | (-1.89) | (-2.05) | (-0.16) | (-0.72) | (-0.82) |
| Household size | -0.0622 | -0.0787 | -0.0571 | -0.142 | -0.115 | 0.0248 |
| | (-0.77) | (-0.82) | (-0.58) | (-1.15) | (-0.90) | (0.20) |
| Northern Uplands | -2.793*** | -1.703** | -1.929** | -3.183*** | -4.770*** | -3.365*** |
| | (-5.15) | (-2.66) | (-2.93) | (-3.82) | (-5.56) | (-4.00) |
| Central Coastal | -2.036*** | -0.759 | -1.332* | -2.648*** | -3.137*** | -2.577*** |
| | (-4.37) | (-1.44) | (-2.46) | (-3.86) | (-4.44) | (-3.72) |
| Mekong River Delta | -1.947*** | -0.432 | -0.907 | -2.541*** | -3.047*** | -3.207*** |
| | (-4.17) | (-0.81) | (-1.66) | (-3.68) | (-4.28) | (-4.60) |
| ehat_c24_stan | 0.991*** | 1.613*** | 1.280*** | 0.850* | 1.076* | 1.331** |
| | (3.45) | (4.85) | (3.74) | (1.97) | (2.42) | (3.05) |
| Observations | 1779 | 1779 | 1779 | 1779 | 1779 | 1779 |

*Robust standard errors in parentheses.* * p<0.10, ** p<0.05, *** p<0.010

*Sources: Author's calculation from YL data*

Appendix 4: Factors affecting the READING score of 15-year-old children controlling for the residual wealth index from 2006 to 2013 via OLS and Quantile Regression

| | OLS | Q(0.10) | Q(0.25) | Q(0.50) | Q(0.75) | Q(0.90) |
|---|---|---|---|---|---|---|
| Gender | -1.603*** | -1.826*** | -1.697*** | -1.654*** | -1.664*** | -1.254*** |
| | (-7.18) | (-4.12) | (-5.03) | (-5.43) | (-6.11) | (-4.28) |
| Urban | 3.234*** | 2.016** | 3.839*** | 3.777*** | 3.593*** | 2.322*** |
| | (8.68) | (2.76) | (6.92) | (7.55) | (8.03) | (4.83) |
| Ethnic mom | 3.110*** | 2.587** | 2.921*** | 3.193*** | 2.980*** | 2.638*** |
| | (8.00) | (2.98) | (4.42) | (5.35) | (5.59) | (4.60) |
| zhfa | 0.203* | 0.201 | 0.286* | 0.258* | 0.130 | 0.302* |
| | (2.11) | (1.09) | (2.03) | (2.04) | (1.15) | (2.48) |
| Mother height | 0.0334 | 0.0429 | 0.0421 | 0.0403 | 0.0383 | 0.0220 |
| | (1.42) | (0.96) | (1.24) | (1.31) | (1.40) | (0.75) |
| Mother weight | -0.0203 | -0.0359 | -0.0156 | -0.0323 | -0.0399 | -0.0241 |
| | (-1.15) | (-0.99) | (-0.56) | (-1.29) | (-1.79) | (-1.01) |
| Household size | -0.0177 | -0.0971 | -0.0227 | -0.00711 | 0.0523 | -0.107 |
| | (-0.29) | (-0.78) | (-0.24) | (-0.08) | (0.68) | (-1.30) |
| Northern Uplands | -0.00566 | 0.701 | 0.130 | 0.0226 | -0.444 | -0.845 |
| | (-0.01) | (0.84) | (0.20) | (0.04) | (-0.86) | (-1.53) |
| Central Coastal | -0.843* | 0.00628 | -0.572 | -0.987* | -1.230** | -0.859 |
| | (-2.39) | (0.01) | (-1.09) | (-2.08) | (-2.90) | (-1.89) |
| Mekong River Delta | -0.0518 | 0.672 | 0.113 | -0.376 | -0.115 | -0.129 |
| | (-0.15) | (0.96) | (0.21) | (-0.79) | (-0.27) | (-0.28) |
| ehat_c24_stan | 0.753*** | 0.749 | 0.868** | 1.001*** | 0.432 | 0.822** |
| | (3.45) | (1.72) | (2.62) | (3.35) | (1.61) | (2.86) |
| Observations | 1781 | 1781 | 1781 | 1781 | 1781 | 1781 |

*Robust standard errors in parentheses.* * p<0.10, ** p<0.05, *** p<0.010

*Sources: Author's calculation from YL data*

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